Claims

We claim:

1. A method for scheduling packets in a router of a packet-switched network having a plurality of service classes, the router including one queue for each service class, each queue storing packets to be transmitted according to the associated service class, comprising:

measuring an average queue length for a particular one of the queues; and

allocating bandwidth to each of the plurality of service classes according to the average queue length.

2. The method of claim 1 wherein the plurality of services classes include a premium service, an assured service, and a best-effort service, and wherein the particular queue is associated with the premium service class.

3. The method of claim 1 wherein the average is an exponential weighted moving average.

4. The method of claim 3 further comprising:
applying a low-pass filter to the an exponential weighted moving average.

5. The method of claim 1 wherein the average queue length is measured every time one packet is stored in the particular queue.

6. The method of claim 1 wherein *avg* is the average queue length, and l is an instantaneous queue length, and f_l is a low-pass filter, and wherein the average queue length is determined by $avg \leftarrow (1 - f_l) \cdot avg + f_l \cdot l$.

7. The method of claim 6 wherein f_l is 0.01.

8. The method of claim 1 wherein the particular queue includes a minimum threshold and a maximum threshold, the maximum threshold representing a desired transmission delay, and the maximum threshold representing an acceptable transmission delay.

9. The method of claim 8 wherein bandwidth for the service class associated with the particular queue is increased when the average exceeds the minimum threshold.

10. The method of claim 9 wherein the bandwidth allocated to the service class remains below a predetermined upper limit when the average exceeds the maximum threshold.

11. The method of claim 1 wherein the plurality of services classes include a premium service *EF*, and wherein the particular queue is associated with the premium service class, and wherein the particular queue includes a minimum threshold T_{min} and a maximum threshold T_{max}, the maximum threshold representing a desired transmission delay, and the maximum threshold representing an acceptable transmission delay, and wherein *avg* is the average queue length, and l is an instantaneous queue length, and f_l is a low-pass filter, and wherein an initial weight of bandwidth for the premium

service is w_p, and an allocated bandwidth weight EF_w of the premium service, as a function of *avg* is

$$EF_w = \begin{cases} w_p, & avg \in [0,0.5) \\ \dfrac{(upper - w_p)\cdot(avg - T_{\min})}{T_{\max} - T_{\min}}, & avg \in [0.5,2) \\ upper, & avg \in [2,s) \end{cases}$$

where *upper* represents a predetermined upper limit when the average exceeds the maximum threshold, and *s* is a size of the particular queue measured in packets.

12. The method of claim 11 where *upper* is *0.7*.

13. A method for scheduling packets in a router of a packet-switched network having a plurality of service classes, the router including one queue for each service class, each queue storing packets to be transmitted according to the associated service class, comprising:

measuring an exponential weighted moving average queue length for a particular one of the queues; and

allocating more bandwidth to the service class associated with the particular queue if the average exceeds a predetermined minimum threshold.